An Analysis of Currency of Computer Science Student Dissertation Topics in Higher Education

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***Abstract*— Year 4 Honours students and MSc students in higher education in British institutions typically complete a moderate piece of work as part of their graduation requirements. In the field of Computer Science, this involves selecting a topic around which students build their dissertation. The field is fast evolving and student interests in the various topics change. This paper presents the results of an investigation that establishes how up-to-date topics of student dissertations were in the academic years 2010 through to 2013. First, dissertations were indexed to establish the topic of the dissertation. Then the topics were mapped on Gartner's Technology Hype Cycle. This paper presents summary statistics for the four year period and it reports on findings of an MSc student dissertation.**

Keywords: higher education analytics; Gartner's Hype Cycle;

I. INTRODUCTION

At British higher education institutions, students on Year 4 Honours programs and also on MSc programs complete a moderate piece of work as part of their graduation requirements. In the field of Computer Science, this involves selecting a topic around which students build their dissertation. The field is fast evolving and student interest in the various topics change, often from year to year. It is of interest to try to establish whether student choices of topics reflects the state of the various technologies in the IT sector, bearing in mind that supervisors influence the choice by providing suggested topics for students to consider.

This paper presents the results of an investigation that established how up-to-date student topics of student dissertations were in the academic years 2010 through to 2013. First, dissertations were indexed to establish the high-level topic of the dissertation that could be mapped on Gartner's Technology Hype Cycle to establish its currency. Summary statistics were then presented for the dissertations covering a four year period.

The paper reports on findings of an MSc student dissertation at Heriot-Watt University in Dubai.

II. GARTNER'S HYPE CYCLE

Foster originally coined the technology life cycle in 1986, tracing a path for business gains that start with research and development through to maturity and eventual extinction [1]. Leading IT research and advisory company Gartner elaborated this concept further [2].

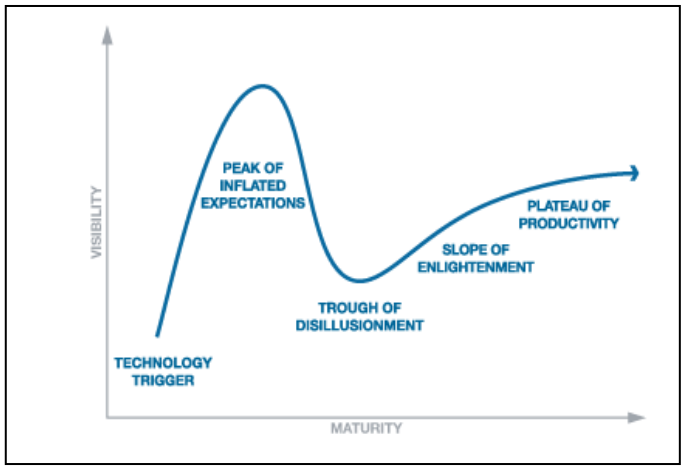

Figure 1. General Shape of Gartner's Hype Cycle Curve [2]

The model plots the maturity of a technology against the visibility of it. The result is a curve that starts at the technology trigger, steeply rising to a peak of inflated expectations dropping to a trough of disillusionment before climbing back via a slope of enlightenment to a plateau of productivity. Figure 1 depicts the general shape of the curve. Every year an updated curve is published with various technologies placed at positions on the curve.

Tables I to V show the evolution of technologies over a 4-year period from 2010 to 2013. So, Table I captures the evolution of technologies that are on the rise, triggered by some innovation in a research lab or a university department. Table II captures the development of the technologies that are at the peak of inflated expectation in the years where expectation of what business opportunity the technology can deliver is at its highest. Table III lists the technologies that are sliding into the trough of disillusionment as the anticipated benefits have not

been realized yet. Feedback from experiences with first implementations is used to iron out teething problems with wider use of the technology. This process leads to Table IV which shows the technologies that are climbing up the slope of enlightenment. Finally, Table V shows the technologies that have reached the plateau of productivity.

TABLE I. GARTNER'S CLASSIFICATION OF TECHNOLOGIES ON THE RISE TRIGGERED BY INNOVATION

2010	Human Augmentation Context Delivery Architecture Computer Brain Interface Terahertz waves Tangible User Interfaces Extreme Transaction Processing Autonomous Vehicles Video Search Mobile Robots Social Analytics 3D Printing Speech-to-Speech Translation
2011	3D Bio-printing Human Augmentation Quantum Computing Computer-Brain Interface Video Analytics for Customer Service Social TV Big Data and Extreme Information Processing and Management Mobile Robots Natural Language Question Answering Internet of Things Speech-to-speech Translation Context-Enriched Services
2012	Human Augmentation Quantum Computing 3D Bio-printing Volumetric and Holographic Displays Automatic Content Recognition 3D Scanners Autonomous Vehicles Mobile Robots Internet of Things Natural-Language Question Answering Silicon Anode Batteries Speech-to-Speech Translation
2013	Bio-Acoustic Sensing Smart Dust Quantum Computing Quantified Self 3D Bio-printing Brain-Computer Interface Human Augmentation Volumetric and Holographic Displays Electro vibration Affective Computing Prescriptive Analytics Autonomous Vehicles Biochips Neurobusiness

TABLE II. GARTNER'S CLASSIFICATION OF TECHNOLOGIES AT THE PEAK OF INFLATED EXPECTATION

2010	Internet TV Private Cloud Computing Augmented Reality Media Tablet Wireless Power 3D Flat-Panel TVs and Displays 4G Standard Activity Streams Cloud Computing Cloud/Web Platforms
2011	Image Recognition 3D Printing Gamification Group Buying Social Analytics Wireless Power Activity Streams Internet TV NFC Payment Private Cloud Computing Augmented Reality Cloud Computing Media Tablet Virtual Assistants In-Memory Database Management Systems
2012	Crowdsourcing Big Data Gamification HTML5

	Hybrid Cloud Computing Wireless Power 3D Printing BYOD Complex-Event Processing Social Analytics Private Cloud Computing Application Stores Augmented Reality In-Memory Database Management Systems Activity Streams NFC Payment
2013	3D Scanners Mobile Robots Speech-to-Speech Translation Internet of Things Natural Language Question Answering Big Data Consumer 3D Printing Gamification Wearable User Interfaces Complex –Event Processing Content Analytics In-Memory Database Management Systems Virtual Assistants

TABLE III. GARTNER'S CLASSIFICATION OF TECHNOLOGIES SLIDING INTO THE TROUGH OF DISILLUSIONMENT

2010	Gesture Recognition Mesh Networks: Sensor Microblogging E-Book Readers Video Telepresence Broadband Over Power Lines Virtual Assistants Public Virtual Worlds Consumer-Generated Media Idea Management Mobile Application Stores
2011	Gesture Recognition Machine-to-Machine Communication Services Mesh Networks: Sensor Cloud/Web Platforms Hosted Virtual Desktops
	Virtual Worlds E-Book Readers
2012	Internet TV Audio Mining/Speech Analytics NFC Cloud Computing Machine-to-Machine Communication Services Mesh Networks: Sensor Gesture Control In-Memory Analytics Text Analytics Home Health Monitoring Hosted Virtual Desktops Virtual Worlds Mobile OTA Payment
2013	Augmented Reality Machine-to-Machine Communication Services Mobile Health Monitoring NFC Mesh Networks: Sensor Cloud Computing Virtual Reality In-Memory Analytics Gesture Control

TABLE IV. GARTNER'S CLASSIFICATION OF TECHNOLOGIES CLIMBING THE SLOPE OF ENLIGHTENMENT

2010	Biometric Authentication Methods Internet Micropayment Systems Interactive TV Predictive Analytics Electronic Paper Location-Aware Applications Speech Recognition
2011	Consumerization QR/Colour Code Idea Management Biometric Authentication Methods Mobile Application Stores Predictive Analytics Speech Recognition
2012	Media Tablets Consumerization Biometric Authentication Methods

	Idea Management Consumer Telematics Speech Recognition
2013	Activity Streams Enterprise 3D Printing Biometric Authentication Methods Consumer Telematics Location Intelligence

TABLE V. GARTNER'S CLASSIFICATION FOR TECHNOLOGIES ENTERING THE PLATEAU OF PRODUCTIVITY

2010	Pen-Centric Tablet PC's
2011	Location-Aware Applications
2012	Predictive Analysis
2013	Speech Recognition Predictive Analytics

III. DOCUMENT INDEXING

Student dissertations are usually uploaded in either PDF or WORD format. All dissertations have a mandatory abstract and most have a similar structure that usually includes an introduction section and also aims and objectives of the work.

There are tools that perform automated indexing of texts, being applicable to documents in a range of formats. As an example, Solr is an open source search platform built around Apache Lucene [3] that is effective in indexing documents.

Here however, the indexing had to be restricted not using a specific ontology, but having the requirement to map to a high-level term on Gartner's Hype Cycle. The documents were hence manually indexed using the abstract in the first instance. Where the abstract was not indicative enough to yield a meaningful subject, the introduction to the dissertation was examined to determine it. Manual indexing requires the skills and expertise of a human indexer and several procedures and instructions exists that can be used as a guide [4].

In total, 226 student dissertations were analysed. Tables VI, VII, VIII and IX show the classification of the student dissertations that could be mapped to respective topics on Gartner's Hype Cycle for the years 2010 through to 2013. The number in brackets shows how many dissertations were in that sub-category.

TABLE VI. CLASSIFICATION OF STUDENT DISSERTATIONS IN 2010

On the rise, triggered by innovation	Mobile Robots (1)
At the peak of inflated expectation	3D Flat-Panel TVs and Displays (1) Cloud/Web Platforms (12) Wireless Power (1) Augmented Reality (3)
Sliding into the trough of disillusionment	Public Virtual Worlds (2) Virtual Assistants (1) Gesture Recognition (2) Mobile Application Stores (2)
Climbing the slope of enlightenment	Predictive Analytics (3) Location-Aware Applications (3) Speech Recognition (2)
Entering the plateau of productivity	(0)

TABLE VII. CLASSIFICATION OF STUDENT DISSERTATIONS IN 2011

On the rise, triggered by innovation	Mobile Robots (3) Video Analytics for Customer Service (1) Natural Language Question Answering (1) Context-Enriched Services (2) Big Data and Extreme Information Processing and Management (1)
At the peak of inflated expectation	Social Analytics (3) In-Memory Database Management Systems (1) Wireless Power (2) NFC Payment (1) Gamification (2)
Sliding into the trough of disillusionment	Virtual Worlds (5) Cloud/Web Platforms (14) Mesh Networks: Sensor (1) Gesture Recognition (1) Predictive Analytics (1)
Climbing the slope of enlightenment	Mobile Application Stores (2) Speech Recognition (2)
Entering the plateau of productivity	Location-Aware Applications (2)

TABLE VIII. CLASSIFICATION OF STUDENT DISSERTATIONS IN 2012

On the rise, triggered by innovation	Mobile Robots (1) Speech-to-Speech Translation (1)

At the peak of inflated expectation	Augmented Reality (2) Gamification (1) Social Analytics (2) Private Cloud Computing (2) Application Stores (3)
Sliding into the trough of disillusionment	Gesture Control (1) Virtual Worlds (2) Text Analytics (3) Mobile OTA Payments (1)
Climbing the slope of enlightenment	Speech Recognition (2) Consumerization (1)
Entering the plateau of productivity	(0)

TABLE IX. CLASSIFICATION OF STUDENT DISSERTATIONS IN 2013

On the rise, triggered by innovation	Affective Computing (3) Prescriptive Analysis (1)
At the peak of inflated expectation	Gamification (1) Content Analysis (1) Internet of Things (5) Virtual Assistants (1) Complex-Event Processing (1) Machine-to-Machine Communication Services (1) Mobile Robots (2) Big Data (1)
Sliding into the trough of disillusionment	Mobile Health Monitoring (3) Cloud Computing (5) Virtual Reality (1) Augmented Reality (3)
Climbing the slope of enlightenment	Location Intelligence (2)
Entering the plateau of productivity	Speech Recognition (1)

IV. RESULTS

With the indexing completed, the summary chart can be prepared and it is shown in Figure 2 below. The first five clusters of bars in the chart show the four-year development of the student topic choices by segment as described in Gartner's Hype, i.e. 'on the rise', 'at the peak', 'sliding into the trough', 'climbing the slope' and 'entering the plateau'.

Cluster six in Figure 2 shows the dissertations where no match could be found to a technology on Gartner's Hype Cycle. This is a relatively large number, and may be a result of a problem with indexing. However, it may also be an expected result as Computer Science does not only cover the applied fields that are depicted on Gartner's Hype Cycle, but also theoretical subjects that cannot easily be mapped to an applied field. Either way, these unclassified dissertations could benefit from further analysis. Dissertations in this category increased from 19 in 2010 to 30 in 2013, representing a percentage points increase from 37% to 48%.

Figure 3 shows the respective percentages of the categories, but excluding the dissertations that could not be mapped, hence there are only five clusters and not six.

The first cluster in Figure 3 shows a slow increase in the student choices of topics that are still emerging, from 3% in 2010 to 13% in 2013 with a spike in 2011 at 17%.

The second cluster captures the trend of the dissertations with topics that are 'at the peak' which in percentage points is slowly decreasing in the years 2010 to 2013 from over 52% to 41% with an obvious dip to 20% in 2011.

The third cluster for the trend of dissertations that cover topics that are classified as 'sliding' seems to be increasing from 21% in 2010 to 38% in 2013 with a notable spike of 49% in 2011. The interest in topics of this category can be explained by the following. While it may be the case that the business community has perhaps lost enthusiasm for a certain technology because it has not delivered anticipated benefits fast enough, the topic itself is still of interest.

The fourth cluster shows a decrease in dissertations falling into the category of 'climbing the slope of enlightenment' from 24% in 2010 to 6% in 2013. The fall is also evident in absolute numbers as can be seen in Figure 2 for that cluster.

The very low number of dissertations based on topics that are classified as 'entering the plateau of productivity' is an expected result. Any technology that is already mainstream in the business world is not likely to be of interest for a dissertation. However, new applications of the technology may be of interested. For example, in 2010, the two dissertations in that category had the titles 'Design and Implementation of a Lift-Sharing Website' and 'Personal Health Monitoring' under the technology topic 'Location-Aware Applications'.

To conclude, the reassuring results from this analysis is the low number of dissertations falling into cluster five. What is also encouraging, is the presence of dissertations in cluster one, bearing in mind that students are Year 4 Honours students or MSc students and not Phd students undertaking state-of-the-art research work. It is also noticeable that clusters two and three are generally higher than cluster four. In some way, clusters two and three can

be considered to belonging to technologies that are still emerging and have not yet matured. As such, interest in them for student dissertations should be higher than technologies that are on the slope of enlightenment.

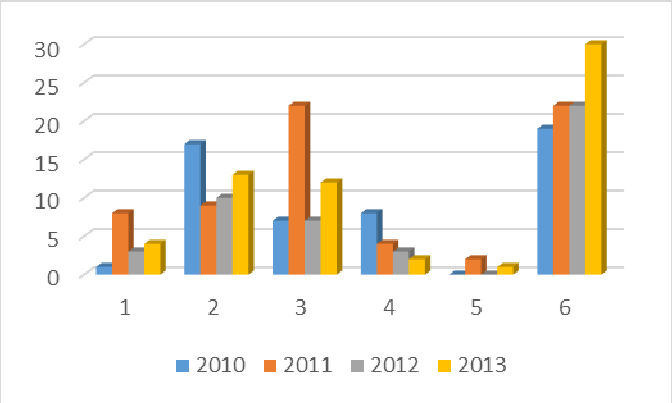

Figure 2. Four-Year Segment Development (in Numbers)

The analysis above needs to be considered within the context of the mechanism in which students choose their topic for the dissertation. Typically, the supervisors will make suggestions that are in line with their own research, and students will make a choice based on the offering. But there are still a number of students who wish to work in a field not put forward. At this stage, no consideration was given to that fact. In other words, where the topic originated is not taken into account, and that in itself can be investigated as well.

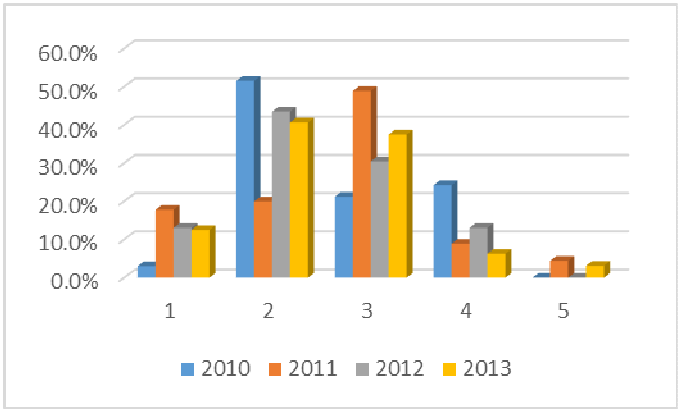

Figure 3. Four-Year Segment Development, Excluding Non-classified Dissertations (in Percentage)

V. FUTHER WORK

This work is based on manual indexing of student dissertations and the next step would be to investigate automated subject indexing to establish whether this will produce acceptable results to automate the process. It is also worth developing a framework that provides student authors with lists of key words that will directly map to the technologies shown on Gartner's Hype Cycle for that year. That would enable both faculty and students to establish the currency of the work before embarking on it. It is also worth investigating alternative frameworks that could be used to establish the currency of the work.

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